Appendix D2
Kreher Park Water Budget Calculations

Water Budget For Kreher Park - Existing Conditions

Recharge at Kreher Park

RE = (P-ET-RO)A

RE = Groundwater Recharge
P = Precipitation (ft/yr) 32 in/yr
ET = Evapotranpiration (ft/yr)
RO = Runoff (ft/yr)
A = Drainage Area (sq. ft.) 11.6 acres

Precipitation for Ashland County

normal	31.91	
		year
high	52.04	1890
low	19.96	1956

Marina Parking Lot **Gravel Covered**

RE 1 = 106,867 cubic ft.
799,901 gallons

P = 2.67 ft./yr.
ET = 1.33 ft./yr.
RO = 0.27 ft./yr.
A = 100,188 sq. ft. 2.3 acres

Percentage of Precipitatic	**From**	**To**
100.00%		
50%	50%	65%
10%	10%	25%

Remainder of Park **Grass Covered**

RE 2 = 378,101 cubic ft.
2,830,084 gallons

P = 2.67 ft./yr.
ET = 1.47 ft./yr.
RO = 0.27 ft./yr.
A = 405,108 sq. ft. 9.3 acres

Percentage of Precipitatic	**From**	**To**
100.00%		
55%	50%	65%
10%	10%	25%

Total Recharge at Kreher Park

RE park = 484,968 cubic ft.
3,629,985 gallons

Filled Ravine Recharge (from gravel covered area north of St. Claire Street)

RE3 = 27,878 cubic ft.
208,670 gallons

P = 2.67 ft./yr.
Ev = 1.33 ft./yr.
Ro = 0.27 ft./yr.
A = 26,136 sq. ft. 0.6 acres

Percentage of		
100.00%		
50%	50%	65%
10%	10%	25%

Groundwater Flow Along Bluff

Q = -KiA

Q = Groundwater discharge
- K = Hydraulic conductivity of the Miller Creek Formation
i = Hydraulic gradient of the Miller Creek Formation
A = Cross section area of bluff.

Q = 3,520 cubic feet per year
26,349 gallons per year

- K = 8.80E-01 cu ft/year 8.50E-07 cm/sec
i = 0.20 ft/ft
A = 20,000 square feet

1,000 length of bluff (ft)
20 saturated thickness of Miller Creek at bluff (ft)

Total Contribution from Upper Bluff

RE bluff = 31,399 cubic ft.
235,019 gallons

Recharge at Kreher Park and from Upper Bluff

RE total = 516,367 cubic ft. 322,084 gal/month
3,865,004 gallons 10,589 gal/day
7.35 gal/min

NOTES:

32 in/yr	average precipitation
17.7 in/yr	average evapotranspiration rate
55.3%	average evapotranspiration percent

Source:
USGS Hydrologic Investigation Atlas HA-524, 1974
Lake Superior Basin
Young & Skinner

Appendix D2
Kreher Park Water Budget Calculations

Water Budget For Kreher Park - Partial Caps

Recharge at Kreher Park

RE = (P-Ev-Ro)A

RE = Groundwater Recharge
P = Precipitation (ft/yr) 32
Ev = Evapotranpiration (ft/yr)
Ro = Runoff (ft/yr)
A = Drainage Area (sq. ft.) 10.5 acres

Precipitation for Ashland County

normal	31.91	
		year
high	52.04	1890
low	19.96	1956

Marina Parking Lot **Asphalt Pavement**

RE1 = 26,717 cubic ft.
199,975 gallons

P = 2.67 ft./yr.
Ev = 0.00 ft./yr.
Ro = 2.40 ft./yr.
A = 100,188 sq. ft. 2.3 acres

Percentage of Precipitation	From	To
100.00%		
0%	0%	10%
90%	80%	95%

Clay Cap - Former Coal Tar Dump Area

RE2 = 11,616 cubic ft.
86,946 gallons

P = 2.67 ft./yr.
Ev = 0.13 ft./yr.
Ro = 2.27 ft./yr.
A = 43,560 sq. ft. 1 acres

Percentage of Precipitation	From	To
100.00%		
5%	1%	10%
85%	70%	90%

Remainder of Park - Grass Covered

RE3 = 248,292 cubic ft.
1,858,466 gallons

P = 2.67 ft./yr.
Ev = 1.48 ft./yr.
Ro = 0.40 ft./yr.
A = 313,632 sq. ft. 7.2 acres

Percentage of Precipitation	From	To
100.00%		
55%	50%	65%
15%	10%	25%

Total Recharge at Kreher Park

RE park = 286,625 cubic ft.
2,145,387 gallons

Contribution to Kreher Park from Filled Ravine

Recharge from Upper Bluff

RE bluff = 13,358 cubic ft.
99,988 gallons

Filled Ravine - Asphalt Pavement

P = 2.67 ft./yr.
Ev = 0.13 ft./yr.
Ro = 2.40 ft./yr.
A = 100,188 sq. ft. 2.3 acres

Percentage of Precipitation	From	To
100.00%		
5%	1%	10%
90%	80%	95%

Recharge at Kreher Park and from Upper Bluff

RE total = 299,983 cubic ft. 187,115 gal/month
2,245,374 gallons 6,152 gal/day
4.27 gal/min

NOTES:

32	in/yr	average precipitation
17.7	in/yr	average evapotranspiration rate
55.3%		average evapotranspiration percent

Source:
USGS Hydrologic Investigation Atlas HA-524, 1974
Lake Superior Basin
Young & Skinner

Appendix D2
Kreher Park Water Budget Calculations

Water Budget For Kreher Park - Cap for Entire Park

RE = (P-Ev-Ro)A

RE = Groundwater Recharge
P = Precipitation (ft/yr) — 32 inches per year
Ev = Evapotranpiration (ft/yr)
Ro = Runoff (ft/yr)
A = Drainage Area (sq. ft.) — 10.5 acres

Marina Parking Lot

					Percentage of Precipitation	From	To
RE1 =	10,687	cubic ft.					
	79,990	gallons	P =	2.67 ft./yr.	100.00%		
			Ev =	0.03 ft./yr.	1%	1%	10%
			Ro =	2.53 ft./yr.	95%	80%	95%
			A =	100,188 sq. ft. (2.3 acres)			

Clay Cap - Entire Kreher Park

					Percentage of Precipitation	From	To
RE2 =	95,251	cubic ft.					
	712,955	gallons	P =	2.67 ft./yr.	100.00%		
			Ev =	0.13 ft./yr.	5%	1%	10%
			Ro =	2.27 ft./yr.	85%	70%	90%
			A =	357,192 sq. ft. (8.2 acres)			

Remainder of Park

					Percentage of Precipitation	From	To
RE3 =	0	cubic ft.					
	0	gallons	P =	2.67 ft./yr.	100.00%		
			Ev =	1.48 ft./yr.	55%	50%	65%
			Ro =	0.40 ft./yr.	15%	10%	25%
			A =	0 sq. ft. (0 acres)			

RE park = 105,938 cubic ft.
792,945 gallons

Contribution to Kreher Park for Filled Ravine

Filled Ravine - Asphalt Pavement

					Percentage of Precipitation	From	To
RE bluff =	13,358	cubic ft.	P =	2.67 ft./yr.	100.00%		
	99,988	gallons	Ev =	0.13 ft./yr.	5%	1%	10%
			Ro =	2.40 ft./yr.	90%	80%	95%
			A =	100,188 sq. ft. (2.3 acres)			

REt = 119,296 cubic ft. — 74,411 gal/month
892,933 gallons — 2,446 gal/day
1.70 gal/min

NOTES:

32	in/yr	average precipitation
17.7	in/yr	average evapotranspiration rate
55.3%		average evapotranspiration percent

Source:
USGS Hydrologic Investigation Atlas HA-524, 1974
Lake Superior Basin
Young & Skinner